UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT(S)	Sumit A. Talwalkar et al.	GROUP ART UNIT:	2637
APPLN. NO.:	09/896,703	EXAMINER:	Meek, Jacob M.
FILED:	June 29, 2001	Confirmation No.	9139
TITLE:	DIGITAL RECEIVER FAST FREQUENCY AND TIME ACQUISITION SYSTEM USING A SINGLE SYNCHRONIZATION WORD AND METHOD OF USING SAME		

DECLARATION UNDER 37 C.F.R. § 1.131

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The following Declaration and attachments are to establish conception in the United States of claimed subject matter in the referenced patent application and diligence to the filing of the referenced patent application on 29 June 2001 from a date prior to the effective date of United States Patent No. US 6,693,983 by Moher et al. which was filed in the United States on 5 October 1999, and relied upon by the Examiner to support a rejection under 35 U.S.C. 103 in the Office Action dated 10 May 2005.

In support of this declaration, I, Sumit A. Talwalkar of Plantation, Florida, declare and say the following:

That I, in association with Vijay Nangia and Leng H. Ooi, my co-inventors in the above-identified patent application, conceived the claimed subject matter of the referenced patent application in the United States before 5 October 1999, the filing date of United States Patent No. US 6,693,983 of Moher et al., in the course of employment by Motorola Inc., wherein the referenced application has been assigned thereto and a copy of the assignment has been attached as Appendix I;
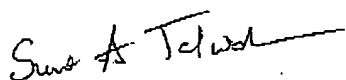
That the claimed subject matter of the referenced patent application was the subject of a written disclosure prepared after conception, which discloses the conception date that is prior to 5 October 1999 and wherein the written disclosure was submitted in a disclosure form, used by the assignee, Motorola Inc., for the purpose

of documenting, considering and maintaining invention disclosures (disclosure attached as Appendix II);

That the conception date which is the earliest verifiable date an individual who is a non-innovator witnessed the claimed subject matter is prior to 5 October 1999 (disclosure form attached as Appendix II);

That on information and belief on or about 26 June 1999 Motorola Inc. received the disclosure for review and subsequently decided to pursue patent protection on the written disclosure, and that thereafter, in due course, a patent application was prepared and filed in the United Stated Patent Office on 29 June 2001 by or on behalf of Motorola Inc.;

That due diligence was exercised from prior to 5 October 1999 to 29 June 2001 to prepare and file the pending patent application number 09/896,703 (emails and inventor information reports attached as Appendix III);

That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Sumit A. Talwalkar   11 July 2005

UNITED STATES PATENT AND TRADEMARK OFFICE

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In support of this declaration, I, Vijay Nangia of Schaumburg, Illinois, declare and say the following:

That I, in association with Sumit A. Talwalkar and Leng H. Ooi, my co-inventors in the above-identified patent application, conceived the claimed subject matter of the referenced patent application in the United States before 5 October 1999, the filing date of United States Patent No. US 6,693,983 of Moher et al., in the course of employment by Motorola Inc., wherein the referenced application has been assigned thereto and a copy of the assignment has been attached as Appendix I;

That the claimed subject matter of the referenced patent application was the subject of a written disclosure prepared after conception, which discloses the conception date that is prior to 5 October 1999 and wherein the written disclosure was submitted in a disclosure form, used by the assignee, Motorola Inc., for the purpose
of documenting, considering and maintaining invention disclosures (disclosure attached as Appendix II);

That the conception date which is the earliest verifiable date an individual who is a non-innovator witnessed the claimed subject matter is prior to 5 October 1999 (disclosure form attached as Appendix II);

That on information and belief on or about 26 June 1999 Motorola Inc. received the disclosure for review and subsequently decided to pursue patent protection on the written disclosure, and that thereafter, in due course, a patent application was prepared and filed in the United Stated Patent Office on 29 June 2001 by or on behalf of Motorola Inc.;

That due diligence was exercised from prior to 5 October 1999 to 29 June 2001 to prepare and file the pending patent application number 09/896,703 (emails and inventor information reports attached as Appendix III);

That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Vijay Nangia
_____
Vijay Nangia   11 July 2005

PATENT

ASSIGNMENT AND AGREEMENT

For good and valuable consideration, the receipt of which is hereby acknowledged, we,
**SUMIT A. TALWALKAR, PLANTATION, FLORIDA, VIJAY NANGIA,
SCHAUMBURG, ILLINOIS, and LENG H. OOI, PLANTATION, FLORIDA** have sold,
assigned and transferred, and do hereby sell, assign and transfer, unto MOTOROLA, INC., a
corporation of the State of Delaware, having its principal office in Schaumburg, State of Illinois,
United States of America, and its successors, assigns, and legal representatives, the entire right,
title and interest for the United States of America in and to certain inventions relating to
improvements in **DIGITAL RECEIVER FAST FREQUENCY AND TIME ACQUISITION
SYSTEM USING A SINGLE SYNCHRONIZATION WORD AND METHOD OF USING
SAME** (Docket No. **CM03093J**), described, illustrated and claimed in an application for Letters
Patent of the United States of America executed by us on the dates indicated by our signatures
below, **filed in the United States Patent and Trademark Office on June 29, 2001, as
Application Serial No. 09/896,703**,together with the entire right, title and interest in and to the
application, and in and to Letters Patent which may be issued upon the application, and upon any
division, extension, continuation or reissue thereof.

We hereby also sell, assign and transfer unto MOTOROLA, INC., the entire right, title
and interest in and to the invention and in and to applications for Letters Patent therefor in all
countries foreign to the United States of America, including all rights under any and all
international conventions and treaties in respect of the invention and the applications for Letters
Patent in foreign countries, and we further authorize MOTOROLA, INC. to apply for Letters
Patent in foreign countries directly in its own name, and to claim priority of the filing date of the
application for Letters Patent of the United States of America under the provisions of any and all
international conventions and treaties.

We hereby authorize and request the Commissioner of Patents of the United States of
America to issue Letters Patent upon the aforesaid application, division, extension, continuation
or reissue, to MOTOROLA, INC., for the sole use and benefit of MOTOROLA, INC., its
successors, assigns and legal representatives, to the full end of the term for which Letters Patent
may be granted, the same as they would have been held and enjoyed by me had this assignment
not been made, and we hereby authorize and request the equivalent authorities in foreign
countries to issue the patents of their respective countries to MOTOROLA, INC.

We agree that, when requested, we will, without charge to MOTOROLA, INC., but at its
expense, sign all papers, take all rightful oaths, and do all acts which may be necessary, desirable
or convenient for securing and maintaining patents for the inventions in any and all countries and

for vesting title thereto in MOTOROLA, INC., its successors, assigns and legal representatives or nominees.

We covenant with MOTOROLA, INC., its successors, assigns and legal representatives, that the interest and property hereby conveyed is free from all prior assignment, grant, mortgage, license or other encumbrance.

_____   DATE: 15 Oct 2001
SUMIT A. TALWALKAR

STATE OF   FLORIDA   )
                                            ss:
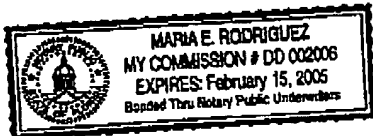COUNTY OF   BROWARD   )

The undersigned Notary Public in and for the County and State aforesaid, do hereby certify that Sumit A. Talwalkar, whose name is subscribed to the foregoing instrument, appeared before me this day in person and acknowledged that they signed, sealed and delivered the instrument as their free and voluntary act and deed for the uses and purposes therein set forth.

Given under my hand and notarial seal this _15_ day of _October_, 2001.

My commission expires:

_____
Notary Public Signature

MARIA E RODRIGUEZ
Printed Name of Notary Public

MARIA E. RODRIGUEZ
MY COMMISSION # DD 002006
EXPIRES: February 15, 2005
Bonded Thru Notary Public Underwriters

_____   DATE: ___October 1, 2001___
VIJAY NANGIA

STATE OF   ILLINOIS   )
                                    ss:
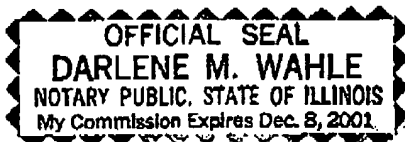COUNTY OF   COOK   )

    The undersigned Notary Public in and for the County and State aforesaid, do hereby certify that Vijay Nangia, whose name is subscribed to the foregoing instrument, appeared before me this day in person and acknowledged that they signed, sealed and delivered the instrument as their free and voluntary act and deed for the uses and purposes therein set forth.

    Given under my hand and notarial seal this __1__ day of _Oct_____, 2001.

My commission expires: _Dec 8, 2001_   _____
                                                  Notary Public Signature

                                                  Darlene M. Wahle
                                                  Printed Name of Notary Public

```
OFFICIAL SEAL
DARLENE M. WAHLE
NOTARY PUBLIC, STATE OF ILLINOIS
My Commission Expires Dec. 8, 2001
```

_____   DATE: 18ᵗʰ — oct 2001

LENG H. OOI

STATE OF   FLORIDA   )
                                                 ss:
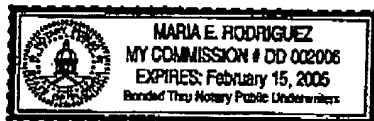COUNTY OF   BROWARD   )

The undersigned Notary Public in and for the County and State aforesaid, do hereby certify that Leng H. Ooi, whose name is subscribed to the foregoing instrument, appeared before me this day in person and acknowledged that they signed, sealed and delivered the instrument as their free and voluntary act and deed for the uses and purposes therein set forth.

Given under my hand and notarial seal this __18__ day of _October_ , 2001.

My commission expires:

_____
Notary Public Signature

MARIA E. RODRIGUEZ
Printed Name of Notary Public

MARIA E. RODRIGUEZ
MY COMMISSION # DD 002006
EXPIRES: February 15, 2005
Bonded Thru Notary Public Underwriters

APPENDIX 1
7 pages

MOTOROLA INC.

| Security Classification |
| Motorola nfidential Proprietary |

DISCLOSURE FOR PATENT COMMITTEE

SUBMITTED PURSUANT TO EMPLOYMENT AGREEMENT

Inventor(s) will not fill in
Operation *HANSEN*
DISCLOSURE NO.   DATE
3093J   *7/26/99*
Patent Committee Action
Inventor(s) Name(s)

FOR INSTRUCTIONS FOR COMPLETION REFER TO DISCLOSURE INSTRUCTION PROCEDURE

Inventor must fill in items 1 thru 12.
Items 2 to 5 may require extra sheets. BE SURE they are signed, witnessed and attached.

1. **Name of the invention. (Limit to ten words.)**

   Fast frequency and time acquisition using a single synchronization word.

2. **State the problem(s) resolved by the invention.**

   Please see the attached sheet.

3. **Describe the invention in detail. Include its operation, purpose, environment and how problem(s) were solved. (Use separate sheets as required.)**

   Please see the attached sheet.

4. **What new elements (e.g. components, circuits, process steps) or combinations of known elements or software algorithm produced the improvement(s) over known technology?**

   Please see the attached sheet.

5. **List the closest known technology (attach article, patent, catalog sheet or other documentation).**

   Please see the attached sheet.

6. **What are the potential applications for use of this invention?**

   Please see the attached sheet.

7. **Conception Date?** 20 June 1999 (Attach earliest log sheets, drawings, etc., to support dates).

8. **To whom did you first disclose this invention? Name: Charles Sobchak**   **Date: 25 June 1999**

9. **Date the device was first built and tested: Simulations conducted during June 1999.**
   Present location of the device?

DETERMINATION OF LEGAL INVENTORSHIP FOR PATENT APPLICATION MUST BE MADE BY THE PATENT DEPARTMENT.

10. Inventor's Full Name: (Type) Sumit Anil Talwalkar	Signature *Sumit Talwalkar*	Date 6 July 1999	Social Security No. ▮▮▮▮▮▮▮

Home Address: Street 1101 NW 81st Terrace	City Plantation	State FL .	Country USA	Zip Code 33322

Citizen of (i.e. U.S., Germany, Etc.) INDIA	Dept. No. EX583	Phone (954)723-6625	Room No. 2381	Employee Status: ☑ Permanent ☐ Contractor

Page 2 — Disclosure No. _____

| Security Classification |
| Motorola Confidential Proprietary |

| 11. Inventor's Full Name: (Type)
Vijay Nangia | Signature | Date
6 July 1999 | Social Security No. |

| Home Address: Street
1499 NW 91st Avenue | City
Coral Springs | State
FL | Country
USA | Zip Code
33071 |

| Citizen of (i.e. U.S., Germany, Etc.)
India | Dept. No.
EX583 | Phone
(954)723-6042 | Room No.
2382 | Employee Status:
✔ Permanent
❑ Contractor |

| 12. Inventor's Full Name: (Type)
Leng H. Ooi | Signature | Date
6 July 1999 | Social Security No. |

| Home Address: Street
632 NW 110 Avenue | City
Plantation | State
FL | Country
USA | Zip Code
33324 |

| Citizen of (i.e. U.S., Germany, Etc.)
Malaysia USA | Dept. No.
EX583 | Phone
(954)723-5467 | Room No.
2391 | Employee Status:
✔ Permanent
❑ Contractor |

Witness signatures (TWO WITNESSES ARE REQUIRED)
Witness must sign this form *and all attachments*.
THE WITNESSES IN SIGNING THIS FORM ATTEST TO THE FACT THAT THEY UNDERSTAND THE INVENTION.

13. Witness Name: Charles Sobchak   Signature _____ Date 7/19/99 Phone 8063

14. Witness Name: Bob Furtaw   Signature _____ Date 7/20/99 Phone 6860

Items 15 to 25 are to be filled in by the ENGINEERING and MARKETING/PRODUCT MANAGER or equivalent. Use separate sheets as required.
THE MANAGERS IN SIGNING THIS FORM ATTEST THAT THEY UNDERSTAND THE INVENTION.

15. What product will this invention be used in? (No code names - use a brief description if necessary)
   This is part of the DIIS protocol which is the emerging standard for digital PMR

16. When (was) (will) the first offer for sale of a product incorporating this invention (be) made?
   Date: 2000

17. When is the estimated shipping date? 2000

18. When (was) (will) the first disclosure outside of Motorola (be) made? How and to whom? Nonclassical-sure agreement signed? State title and date of publication, if any.
   We need to disclose this invention at some point in 1999 to the ETSI ad hoc meeting on DIIS.

19. What is the market for products incorporating this invention?
   DIIS protocol is the emerging standard for world-wide protocol for digital PMR.

20. Who are the potential competitors? What is the possibility this invention will be used by compete-tons? Which ones?
   Matra-Nortel, Simoco and Nokia are potential competitors. DIIS will be an open standard and we will retain the essential IPR in this area.
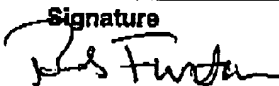
Page 3 — Disclosure No. _____

21. Did this invention result from work on a development contract?   (YES) (NO) Contract No. _____
    Who was the contracting party? No.

22. Discuss the business impact that this invention will have on Motorola. Be specific and quantitative.

    Transmit interrupt capability is an important feature of DIIS radio. This technique allows for acquisition (carrier, symbol time and frame synch) using a single 5 ms long synchronization word. This facilitates operation the transmit interrupt feature through a repeater.

23. Engineering Manager's Name (Type)	Signature	Date	Dept. No.	Phone
~				

24. Product / Marketing Manager's Name (Type) Bob Furtaw	Signature	Date	Dept. No.	Phone
	Bob Furtaw	7/26/99	30303	6800

25. The Manager must determine the security classification of this information.   See Personnel Policy #840, and Corporate SOP E60, "Protection of Proprietary Information".

2. State the problem(s) resolved by the invention.

Time and frequency synchronization is essential for reliable transmission between the transmitting (Tx) and receiving (Rx) radios. Time synchronization refers to symbol time synchronization (knowledge of boundary between successive symbols) as well as frame synchronization. Frequency synchronization is necessary because the reference oscillators in the two radios (Tx and Rx) have different errors from the nominal frequency. This invention addresses the problem of acquiring synchronization (both time and frequency) by using a single 5 ms long synchronization word. This solution for fast acquisition enables the operation of the transmit interrupt feature that is one of the distinguishing features of the new digital PMR protocol, DIIS.

3. Describe the invention in detail. Include its operation, purpose, environment and how problem(s) were solved. (Use separate sheets as required.)

The operation of the sync acquisition system depends on a known sequence of symbols that is periodically embedded in the transmit symbol stream. This sequence of symbols, already known to the receiver, is called the synchronization word. The call related information is sent immediately after the sync word. This way any receiver coming up on the air starts looking for the sync word and the call information to decide whether to participate in a call. The functional diagram of a receiver may be similar to the one shown in Figure 1. The next paragraph briefly mentions some weaknesses
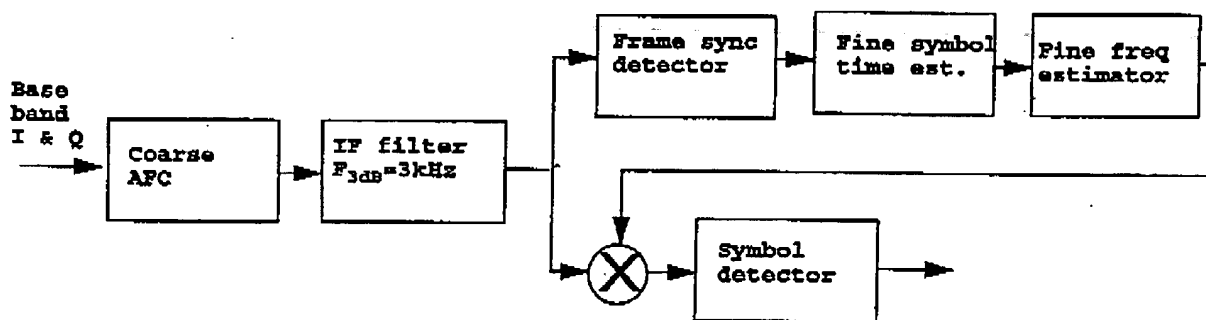

Figure 1. Functional diagram of a typical receiver

of this receiver functional diagram.

The IF filter with a 3-dB band width of 3 kHz is required for meeting the adjacent channel interference protection requirement. With this 3-dB band width, a maximum offset of 600 Hz is acceptable at the input of the IF filter. According to the standards specification 5.1.1 of ETS 300 113[1], however, a mobile transmitter frequency is allowed to be up to 1.5 kHz away from its nominal value for a channel separation of 12.5 kHz. Thus, if the base band I-Q signal is directly fed to the IF filter, in the worst case difference of 3 kHz between Tx and Rx, a significant part of the signal itself gets attenuated by the IF filter. This is the reason for the coarse AFC is placed before the IF filter. The coarse AFC is supposed to bring the offset down from 3 kHz to 600 Hz. The coarse AFC, however, has to operate on unknown data symbols before the sync word, for the sync word to pass through the IF filter.

In view of the difficulties encountered with the receiver above, the functional diagram of the invention can now be considered. The diagram is shown in Figure 2. Note the following differences in this new diagram with respect to the one in Figure 1. On the upper branch the base band I-Q signal is filtered through an IF filter with the 3-dB band width of 6 kHz, twice the original value. Frame sync detector is now operating in the presence of greater noise power since the filter in front of the frame sync detector is wider. This causes a degradation in the performance of the frame sync detector. Simulations verify, however, this performance degradation to be acceptable[2]. Next is the symbol time estimator. Due to increased noise power, the estimator can only make a coarse estimate. The crucial point here is that the frequency estimation algorithm tolerates greater timing error than the symbol detector itself. In case if the timing error is unacceptable for the frequency estimator, the estimator may be run two or three times with timing slightly advanced or delayed

1. ETS 300 113, "Radio Equipment and Systems (RES); Land Mobile Services; Technical characteristics and test conditions for radio equipment intended for the transmission of data (and speech) and having an antenna connector", June 1996.
2. "Acceptable" performance implies that break down of the frame sync detector occurs at a lower value of Eb/N0 than that of the symbol detector.
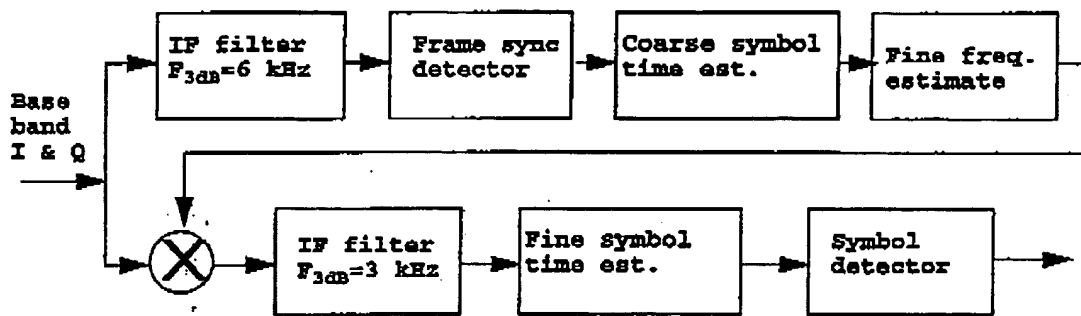
Figure 2. Functional diagram of proposed invention

with respect to the coarse timing estimate. The frequency estimator can estimate offsets between -3 and +3 kHz. Note that the frame sync detection, symbol time estimation and frequency estimation all use the same part of the signal that corresponds to the sync word. Since, the frequency estimation is based on known sequence of symbols, it is much more fast and accurate compared to the coarse AFC in Figure 1.

The frequency correction is now applied to the base band I-Q signal. Frequency corrected signal is then passed through a narrower IF filter. Note that with the frequency correction applied, there is no danger of the IF filter attenuating a signal with high offset. The filtered signal is then used for symbol time estimation. This symbol time estimation is more accurate because the narrower IF filter allows smaller amount of noise into the estimate.

The IF filters are implemented in FIR filters. It is no co-incidence that the wider IF filter is chosen have a 3-dB band width which is an integral multiple (2 in this case) of the narrower IF filter. Such choice allows the taps of the wider IF filter to be derived from the narrower IF filter. In this case, we take every other tap of the narrower IF filter to be a tap of the wider IF filter. Thus, the addition of a filter does not come at the cost of increased memory requirement.

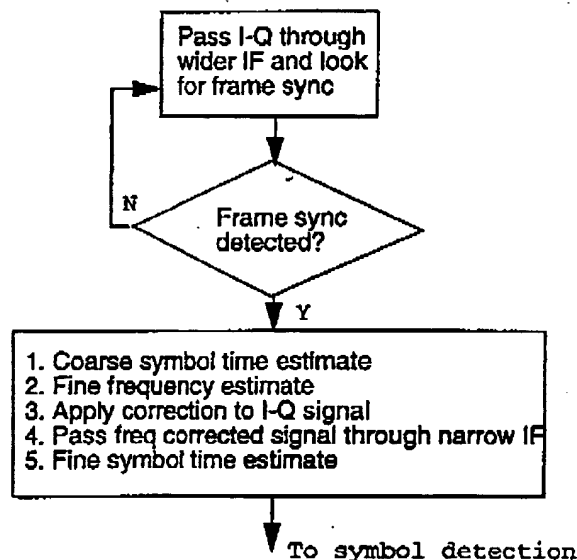· Figure 3 shows the flow chart of acquisition algorithm of the invention.

Figure 3 Acquisition algorithm flow chart

The timing diagram (not to scale) is shown in Figure 4. As shown in the diagram, minimum acquisition time is reduced from anywhere greater than 30 ms to as small as 5 ms. The saving in minimum acquisition time comes from the fact that coarse AFC does not have to be run on unknown symbols.

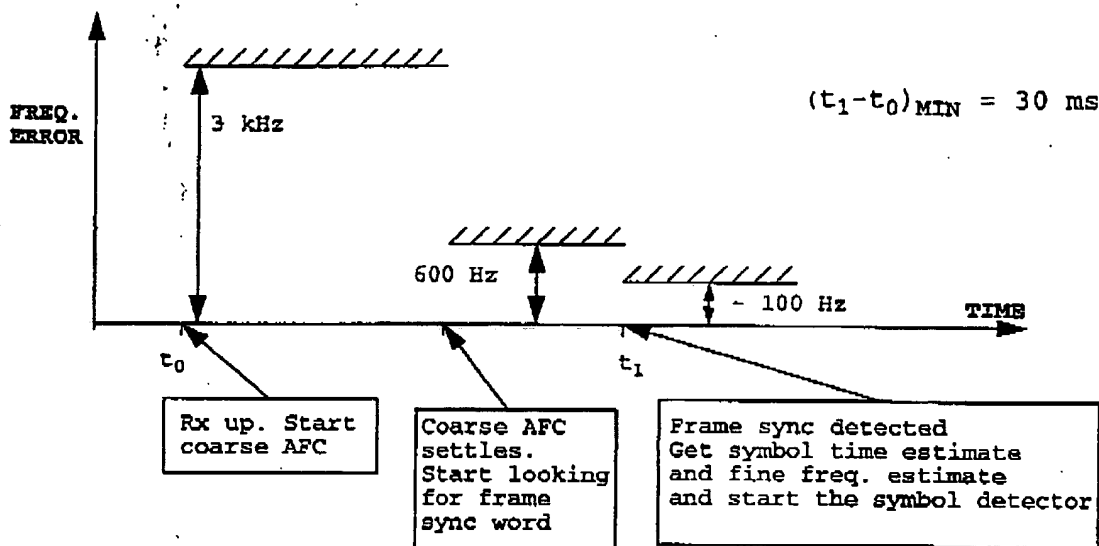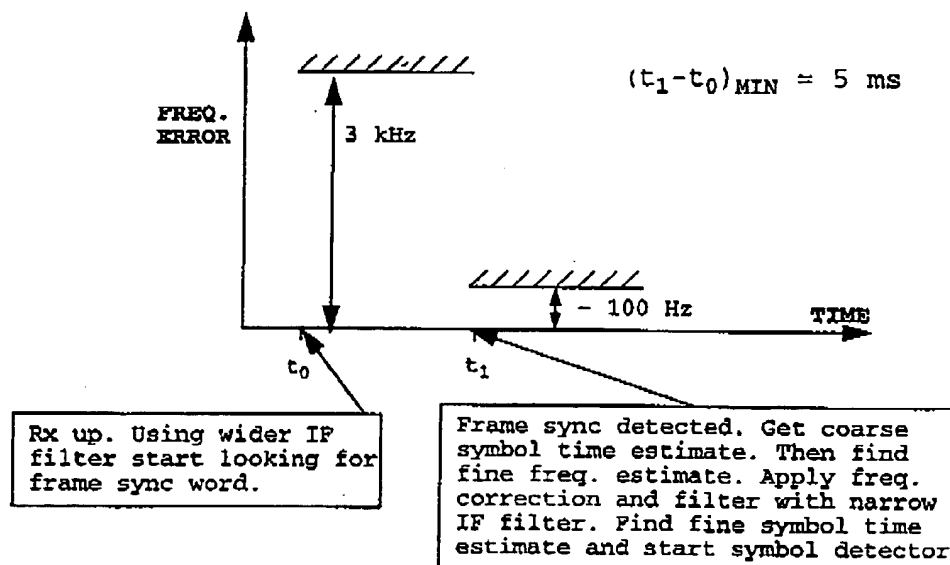| DATA	SYNC WORD	CALL INFORMATION	DATA

(A) Frame structure

FREQ. ERROR

3 kHz

$(t_1-t_0)_{MIN} = 30$ ms

600 Hz

~ 100 Hz

TIME

t_0

t_1

Rx up. Start coarse AFC

Coarse AFC settles. Start looking for frame sync word

Frame sync detected
Get symbol time estimate
and fine freq. estimate
and start the symbol detector

(B) Scheme from Fig.1

FREQ. ERROR

3 kHz

$(t_1-t_0)_{MIN} = 5$ ms

~ 100 Hz

TIME

t_0

t_1

Rx up. Using wider IF filter start looking for frame sync word.

Frame sync detected. Get coarse symbol time estimate. Then find fine freq. estimate. Apply freq. correction and filter with narrow IF filter. Find fine symbol time estimate and start symbol detector

(C) Scheme from proposed invention

Figure 4. (A) The frame structure containing the sync word followed by
the call information embedded in the data stream, (B) and (C) Timing
diagrams (not to scale) showing the frequency error vs. time for the
two schemes: One shown in Figure 1 and the invention shown in Figure 2

Sumit & Tabsath   6 July 1999

4. What new elements (e.g. components, circuits, process steps) or combinations of known elements or software algorithm produced the improvement(s) over known technology?

The invention makes use of the observation that frequency offset estimation is more tolerant than the symbol detector to the error in symbol time estimation. This allows use of coarse symbol time estimator which in turn allows a wider IF filter that tolerates maximum expected frequency offset. Such an arrangement eliminates the need for use of a coarse AFC before the IF filter. Elimination of a coarse AFC that relies on unknown data symbols makes the invention fast in acquiring synchronization based only on a single 5 ms long synchronization word.

Another new element of the invention is the idea of obtaining the wider filter from the narrower one without additional memory requirement.

5. List the closest known technology (attach article, patent, catalog sheet or other documentation).

[1] Mengali, U. and D'Andrea, A. N., "Synchronization Techniques for Digital Receivers", Plenum Press, 1997.

6. What are the potential applications for use of this invention?

Many digital modulation protocols make use of sync word. They all can benefit.

Saccocio Jerilyn-a10170

From:	Vijay Nangia [Vijay_Nangia-EVN003@email.mot.com]
Sent:	Thursday, September 21, 2000 2:08 PM
To:	Saccocio Jerilyn-a10170
Subject:	Re: Disclosure 3093J....

Jerilyn, Please send it to:
Vijay Nangia
Motorola Inc.,
1301 E. Algonquin Rd,
Room 2928,
Schaumburg, IL 60196

Thanks.

Saccocio Jerilyn-a10170 wrote:

> Vijay, what address should I use when sending a federal express
package?
>
> -----Original Message-----
> From: Vijay Nangia [mailto:Vijay_Nangia-EVN003@email.mot.com]
> Sent: Thursday, September 21, 2000 1:45 PM
> To: Saccocio Jerilyn-a10170
> Subject: Re: Disclosure 3093J....
>
> Vijay Nangia
>
> 1139 Pine Valley Drive, #304
> Schaumburg, IL 60173
>
> India
>
>
>
> Saccocio Jerilyn-a10170 wrote:
>
> > Please provide the following information in order that we may
prepare the
> > paperwork required to file a patent application with the U.S. Patent
> Office:
> >
> > Full Name (including middle name or initial):
> >
> > Home Address:
> >
> > Citizenship:
> >
> > Social Security Number:
> >
> > Thank you,
> >
> > Jerilyn S. Saccocio
> > Administrative Assistant to Jim Lamb
> > Intellectual Property Section
> > Law Department
> > FL08/Room 1610
> > Telephone: (954) 723-6449
> > Fax: (954) 723-3871
> > email: jerilyn.saccocio@motorola.com
> >
> > Mailing and Federal Express Address:
> > Motorola, Inc.

1

Saccocio Jerilyn-a10170

From: Sumit Talwalkar [Sumit_Talwalkar-EST004@email.mot.com]
Sent: Thursday, September 21, 2000 1:43 PM
To: Saccocio Jerilyn-a10170; Sumit Talwalkar
Subject: Re: Disclosure 3093J....

Saccocio Jerilyn-a10170 wrote:
>
> Please provide the following information in order that we may prepare
the
> paperwork required to file a patent application with the U.S. Patent
Office:
>
> Full Name (including middle name or initial):

Sumit Anil Talwalkar
(first)   (m)   (last)

>
> Home Address:

1101 NW 81st Terrace
Plantation, FL 33322

>
> Citizenship:
Indian

>
> Social Security Number:

~~XXX-XX-XXXX~~

>
> Thank you.
>
> Jerilyn S. Saccocio
> Administrative Assistant to Jim Lamb
> Intellectual Property Section
> Law Department
> FL08/Room 1610
> Telephone: (954) 723-6449
> Fax: (954) 723-3871
> email: jerilyn.saccocio@motorola.com
>
> Mailing and Federal Express Address:
> Motorola, Inc.
> Intellectual Property Section
> Law Department - Room 1610
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From: Vijay Nangia [Vijay_Nangia-EVN003@email.mot.com]
Sent: Thursday, September 21, 2000 1:45 PM
To: Saccocio Jerilyn-a10170
Subject: Re: Disclosure 3093J....

Vijay Nangia

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▄▄▄▄▄▄▄▄▄

Saccocio Jerilyn-a10170 wrote:

> Please provide the following information in order that we may prepare
the
> paperwork required to file a patent application with the U.S. Patent
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> Thank you,
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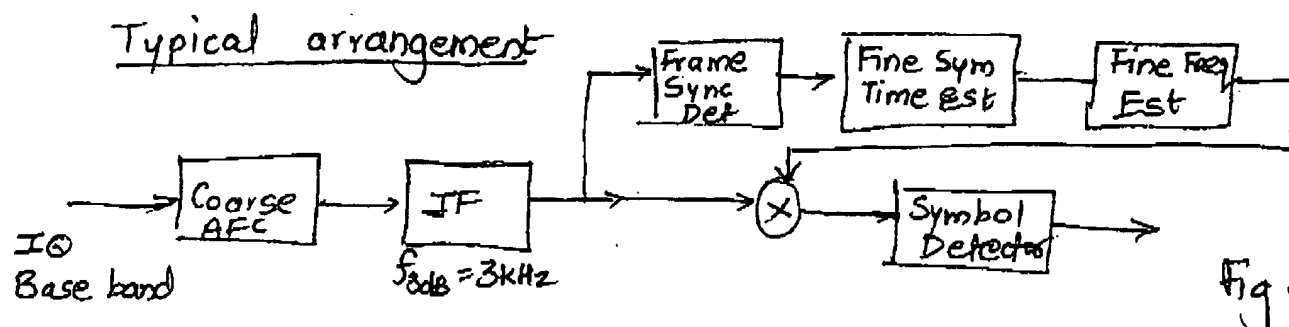
TITLE

Dual IF ~~FAST~~ Sync Acquisition.

MODEL

Typical arrangement

Fig. 1

IF filter $BW_{3dB} = 3$ kHz to meet adj. chan. interference

rejection ratio (ACIRR) requirement. Frame sync looks for

the frame sync word. I-Q baseband can be up to

± 3 kHz ~~are~~ off. This will attenuate the signal going thro'

IF filter. IF filter can tolerate only up to ± 600 Hz offset. Coarse AFC is reqd. Note that the coarse

has to bring ~~the offset~~ down from ± 3 kHz to ± 600 Hz.

Note that the coarse AFC has to acheive this while looking at

unknown data symbols (and not a known synchronization word).

This causes the coarse AFC to be slow. ∴ we propose a two-stage

acquisition. The two stage acquisition is done using a single

5 ms (30 symbols @ 6 ksymbols/s) long sync word.

The slow coarse AFC is eliminated. Thus, the synchronization speed

is improved. The arrangement is shown in Fig2 on next page.

WRITER

DATE 1999 WITNESS

DATE

TITLE Dual IF fast Acquisition   MODEL
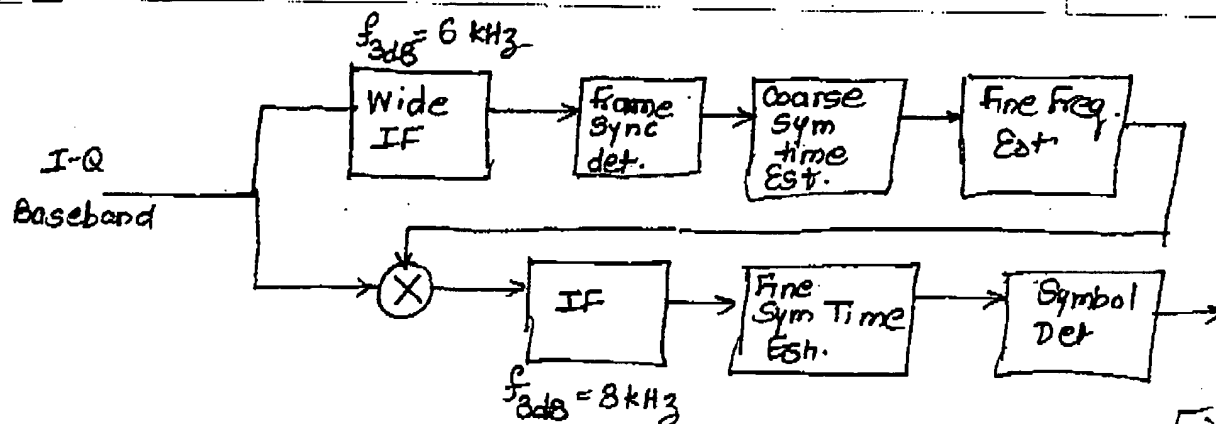
$f_{3dB} = 6 \text{ kHz}$

Fig. 2

In this arrangement the I-Q signal is passed through a wider IF filter with $f_{3dB} = 6 \text{ kHz}$ (instead of 8 kHz). See the upper branch in the figure above. The wider IF allows signal with a maximum offset of $\pm 3 \text{ kHz}$ to pass through. However, it also lets more noise power to pass through. This degrades the performance of the following frame sync. detector which looks for the presence of the sync word. Note that there is no coarse AFC transient necessary before the arrival of the sync word. The degradation in the performance of the sync detector was found to be quite acceptable in our application (approx. (P_{det}) ≥ 97%). The frame sync detector, Upon detection by the the signal corresponding to the sync word is fed to the coarse symbol time estimator. This estimate is noisier (due to wide IF), and thus, we call it a coarse symbol time estimator.

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TITLE	MODEL
Dual IF Fast IF Acquisition	

Using the symbol time estimate, we then run the maximum likelihood estimator to find the carrier offset up using the same signal corresponding to the # sync word. The key here is that the freq. estimator is more tolerant to timing of error than the symbol detector. If the symbol time error is unacceptable, it is suggested that the freq. estimator is run a multiple (2-3) times with slight advance/delay. The freq. estimate is used to correct the I-Q signal to be then passed thro the regular IF filter with $f_{3dB} = 3 \, kHz$. Following a finer sym. time estimator the signal goes to the symbol detector.

The wider IF is derived from the regular IF filter, by (both FIR) using every alternate tap. This may be generalized to every n^{th} tap depending on the ratio of f_{3dB} of wider IF and regular IF; (frame sych det. performance degradation permitting). Thus, the second IF needs no extra memory.

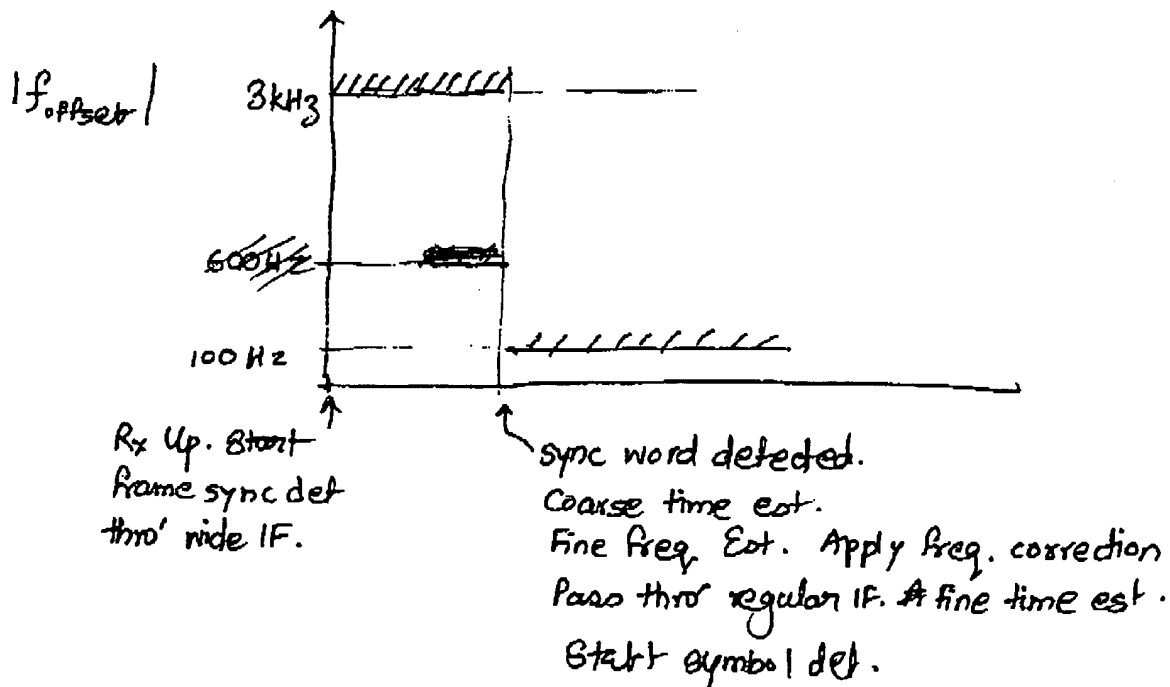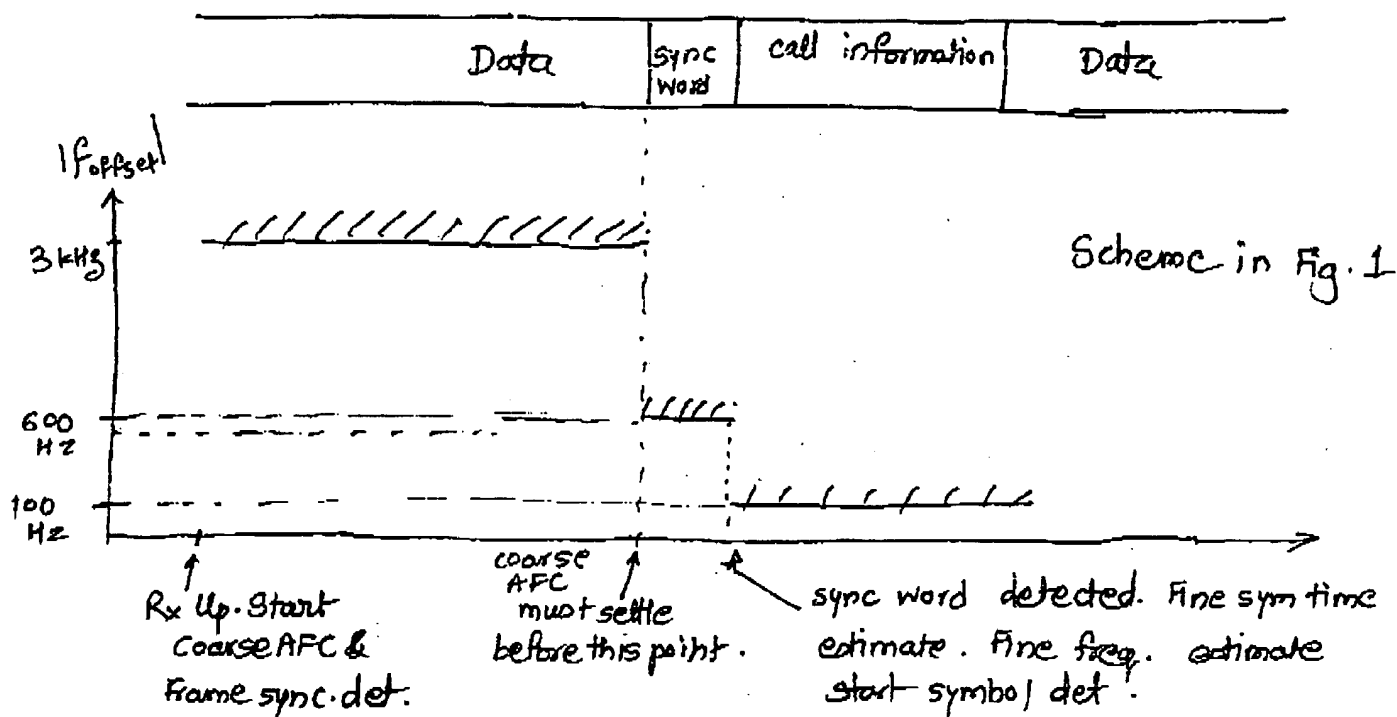Timing diagram corresponding to the two schemes (Fig 1 & Fig 2) shown on the next page.

WRITER	DATE	WITNESS	DATE
G. L. A. Todk			

MOTOROLA ENGINEERING LOG SHEET PAGE 4 OF 4 PAGES No. 794825

TITLE	MODEL
Dual IF Fast Acquisition	

Data	Sync Word	call information	Data

$|f_{offset}|$

3kHz

600 Hz

100 Hz

Scheme in Fig. 1

Rx Op. Start
Coarse AFC &
Frame sync. det.

coarse
AFC
must settle
before this point.

sync word detected. Fine sym time
estimate. Fine freq. estimate
start symbol det.

$|f_{offset}|$ 3kHz

600Hz

100 Hz

Rx Op. Start
Frame sync det
thro' wide IF.

sync word detected.
Coarse time est.
Fine Freq. Est. Apply freq. correction
Pass thro' regular IF. A fine time est.
Start symbol det.

WRITER	DATE	WITNESS	DATE

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Job Description:	ENGR ELECTRONICS SR
Party Comments:	

* denotes information source is PC Master

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*Party Comments:	

* denotes Information source is PC Master